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12/06/01
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WE CLAIM

1. A method of embedding data in an information signal representing material. the method comprising:

combining the information signal with a function of the data and a scaling factor, the data being recoverable from the combination by a decoding process; wherein the information signal, prior to forming the combination, is subject to the decoding process as trial; and

the scaling factor is generated as a function of the trial decoding process.

2. A method according to claim 1, wherein the step of combining involves modulating a pseudo random symbol sequence with the said data and the trial decoding comprises the step of correlating a pseudo random symbol sequence with the said representation of the material. and the scaling factor is generated in dependence on the result of the correlation.

3. A method of embedding data in an information signal representing material comprising the steps of:

combining, as a trial, a representation of the material with a function of the data and a trial scaling factor;

performing, as a trial, a predetermined process on the combined material and data;

Performing a trial decoding of the processed combined material and data; and

Adjusting the scaling factor as a function of the trial decoding of the processed combined material and data.

4. A method of embedding data bits in material. the method comprising the steps of:

producing transform coefficients Ci representing a transform of the material;

producing a pseudo random symbol stream having L symbols Pi of values +1 and -1;

calculating modified coefficient values Ci' = Ci + α * Pi, where α is calculated dependent on S and the value of the data bit to be embedded in the coefficient.

5. A method according to claim 4 wherein

$$\alpha = (\alpha' + \text{offset})$$

where α' + offset is a function of the data bit to be embedded in the coefficient,

α' = 0 if S is positive and the data to be concealed is a symbol of a first value,

α' =0 if S is negative and the data to be concealed is a symbol of a second value, and

otherwise α' is a function of S such that Σ Ci'.Pi has the correct sign to represent the symbol to be encoded.

6. A method according to claim 5, wherein the first value is "1" and the second value is "0".

7. A method according to claim 4, wherein the said function of S is

α' = - S/(L-1) or α' = - S/L.

8. A method according to claim 4, wherein the magnitude of the offset is greater than or equal to zero.

9. A method according to claim 8, wherein the magnitude of the offset is one.

10. A method according to claim 4, wherein the said coefficients are coefficients of a wavelet transform of the material.

11. A method according to claim 4, wherein the data to be embedded includes a UMID.

12. A method of removing data from material, which data has been embedded by the method of claim 4, the method comprising the steps of:

calculating the correlation $S'=\Sigma Ci'*Pi$ for i=1 to L where Pi are the bits of the PRSS and have values +1 and -1:

calculating α_r as a function of S'; and

calculating $Ci=Ci'-\alpha_r.Pi$ to recover the unmodified coefficients Ci.

13. A method according to claim 12, wherein $\alpha_r=S'/(L-1)$ or $\alpha_r=(S'/L)$.

14. A method according to claim 12, further comprising deriving the symbols of the concealed data from S', where if S' is positive a symbol is of the first value and if S' is negative a symbol is of the second value.

15. A method according to claim 12, comprising the step of generating and synchronizing a reference pseudo random symbol sequence with the pseudo random symbol sequence of the embedded data.

16. A computer program product arranged to carry out the method of claim 1, when run on a computer.

17. Apparatus for embedding data in an information signal representing material, the apparatus comprising:

a combiner for producing a combination of the information signal with a function of the data and a scaling factor;

a decoder for decoding the information signal to recover the data therefrom; and

a generator for generating the scaling factor wherein the scaling factor is generated as a function of a trial decoding of the information signal prior to forming the combination.

18. Apparatus according to claim 17, wherein:

the combiner includes a modulator for modulating a pseudo random symbol sequence with the said data;

the decoder comprises a correlator for correlating the pseudo random binary sequence with the said information signal: and

the scaling factor generator is arranged to generate the scaling factor in dependence on the result of the correlation.

19. Apparatus for embedding data in an information signal representing material, comprising a combiner arranged to combine, as a trial, a representation of the material with a function of the data and a trial scaling factor:

and further comprising:

a processor for performing, a predetermined process on the combined information signal and data;

a decoder for recovering the data from the processed combined information signal and data and a generator for generating the scaling factor as a function of decoding of the processed combined information signal and data.

20. Apparatus for embedding data in material, the apparatus comprising:

a transformer for producing transform coefficients Ci representing a transform of the material;

a generator for producing a pseudo random symbol stream having L bits Pi;

an input for receiving symbol representing the data to be concealed; and

a data embedder arranged to

calculate a correlation $S=\Sigma Ci*Pi$, for i=1 to i=L and

calculate modified coefficient values $Ci' = Ci + \alpha * Pi$, where α is calculated dependent on S and the value of the data bit to be embedded in the coefficient.

21. Apparatus according to claim 20 wherein

$$\alpha = (\alpha' + \text{offset})$$

where $\alpha' + \text{offset}$ is a function of the data bit to be embedded in the coefficient, and the apparatus is arranged to

calculate modified coefficient values Ci' = Ci + (α'+ offset)*Pi where

α'=0 if S is positive and the data to be concealed is a bit of a first value,

α' =0 if S is negative and the data to be concealed is a bit of a second value. and

otherwise α' is a function of S such that Σ Ci'.Pi has the correct sign to represent the bit to be encoded.

22. Apparatus according to claim 21, wherein the first value is "1" and the second value is "0".

23. Apparatus according to claim 21, wherein α' -S/(L-1) or -S/L

24. Apparatus according to claim 20, wherein the offset is greater than or equal to zero.

25. Apparatus according to claim 25 wherein the offset = 1.

26. Apparatus according to claim 20, wherein the coefficients are coefficients of a wavelet transform of the material.

27. Apparatus according to claim 20, comprising a generator for generating a UMID as the said data to be embedded.

28. Apparatus for removing data from material, which data has been embedded by the apparatus of claim 20, the apparatus comprising:

a generator for generating a PRSS; and

a calculator for calculating

the correlation S'=Σ Ci'.Pi for i= 1 to L where Pi are the bits of the PRSS,

a value α_s dependent on S', and

a coefficient value Ci=Ci'-α_s.Pi to recover the unmodified coefficients Ci.

29. Apparatus according to claim 26, wherein α_r=S/(L-1) or (S/L).

30. Apparatus according to claim 28, further comprising a decoder for deriving the bits of the concealed data from the correlation value S', where if S' is positive a bit of the data has a first value and if S' is negative a bit of the data has a second value.

31 Apparatus according to claim 28, comprising a synchronizer for synchronizing the generated PRSS with the PRSS of the embedded data.

32. A method of embedding data in material, comprising the steps of:

producing transform coefficients Ci of the material;

comparing the magnitudes of the coefficients with a threshold value T; and

producing, from the coefficients Ci and the said data, modified coefficient values Ci' which are modified by respective information symbols of a pseudo random symbol sequence modulated by the said data to be embedded;

wherein the said step of producing modified coefficient values does not use coefficients of magnitude greater than the said threshold T and does not use the corresponding information symbols.

33. A method according to claim 32, wherein the modified coefficients

$$Ci'= Ci +\alpha.Pi$$

where $\alpha.Pi$ is an information symbol modulated by the data to be embedded. α being a scaling factor.

34. A method according to claim 33, wherein α is dependent on the data.

35. A method according to claim 33, wherein α is of fixed value.

36. A method according to claim 32, wherein the modified coefficients

$$Ci'= Ci +\alpha.Ri$$

where Ri is an information symbol Pi modulated by the data, and α is a scaling factor.

37. A method according to claim 32, wherein the said transform is a wavelet transform.

38. A method according to claim 32, wherein the said transform is a spatial frequency transform.

39. A method for detecting data embedded in material, the detecting method comprising

receiving transform coefficients of the material;

comparing the magnitudes of the received coefficients with a threshold value T; and

correlating the said coefficients with a respective symbols of a pseudo random symbol sequence to detect the said data, wherein the correlating step does not use coefficients of magnitude greater than the said threshold T and corresponding symbols of the pseudo random symbol sequence.

40. A method according to claim 39, further comprising removing the said data from the said received coefficients not using coefficients of magnitude greater than said threshold T.

41. A method of detecting data embedded in material, the method comprising;

receiving transform coefficients of the material;

comparing the magnitudes of the received coefficients with a threshold Tclip;

clipping, to a magnitude Tclip, the magnitude of coefficients of magnitude greater than the said threshold Tclip; and

correlating the clipped and unclipped coefficients with a pseudo random symbol sequence to detect data embedded in the material.

42. A method according to claim 41, further comprising removing data from said clipped and unclipped coefficients.

43. (Amended) A method of embedding data in material, comprising the steps of:

producing transform coefficients Ci of the material;

comparing the magnitudes of the coefficients with a threshold value T; and

producing, from the coefficients Ci and the said data, modified coefficient values Ci' which are modified by respective information symbols of a pseudo random symbol sequence modulated by the said data to be embedded;

wherein the said step of producing modified coefficent values does not use coefficients of magnitude greater than the said threshold T and does not use the corresponding information symbols; and detecting the data by

receiving transform coefficients of the material;

comparing the magnitudes of the received coefficents with a threshold Tclip;

clipping, to a magnitude Tclip, the magnitude of coefficients of magnitude greater than the said threshold Tclip; and

correlating the clipped and unclipped coefficients with a pseudo random sybmol sequence to detect data embedded in the material.

44. A method of embedding data in material, the method comprising

receiving transform coefficients Ci representing the material;

comparing the magnitudes of the said transform coefficients Ci with a threshold Tclip;

clipping, to the magnitude Tclip, the magnitudes of those of the coefficients having a magnitude exceeding Tclip to produce clipped coefficients; and

producing modified coefficients Ci' values dependent on a scaling factor and the data to be embedded, and the scaling factor is calculated using the said clipped coefficients and the coefficients Ci of magnitude less than Tclip.

45. A computer program product arranged to carry out the method of 32. when run on a computer.

46. Apparatus for embedding data in material, comprising:

a transformer for producing transform coefficients Ci of the material;

a comparator for comparing the magnitudes of the coefficients with a threshold value T; and

a combiner for producing, from the coefficients Ci and the said data, modified coefficient values Ci' which are modified by respective information symbols of a pseudo random symbol sequence modulated by the said data to be embedded, wherein the combiner does not use coefficients of magnitude greater than the said threshold T and does not use the corresponding information symbols.

47. Apparatus according to claim 46, wherein the combiner is arranged to produce modified coefficients

$$Ci' = Ci + \alpha.Pi$$

where $\alpha.Pi$ is an information symbol modulated by the data to be embedded, α being a scaling factor.

48. Apparatus according to claim 47, wherein α is dependent on the data.

49. Apparatus according to claim 47, wherein α is of fixed value.

50. Apparatus according to claim 46, wherein the combiner is arranged to produce coefficients

$$Ci' = Ci - \alpha.Ri$$

where Ri is an information symbol Pi modulated by the data, and α is a scaling factor.

51. Apparatus according to claim 50, comprising a pseudo random sequence generator and a modulator for modulating the pseudo random sequence with the said data.

52. Apparatus according to claim 46, wherein the said transformer is a wavelet transformer.

53. Apparatus according to claim 46, wherein the said transformer produces a spatial frequency transform of the said material.

54. Apparatus for detecting data embedded in material, the detecting apparatus comprising

an input for receiving transform coefficients of the material;

a comparator for comparing the magnitudes of the received coefficients with a threshold T; and

a correlator for correlating the said coefficients with respective symbols of a pseudo random symbol sequence to detect the said data, wherein the correlation does

not use coefficients of magnitude greater than the said threshold T and the corresponding symbols of the pseudo random symbol sequence.

55. Apparatus according to claim 54, further comprising a data remover for removing data from the receiving coefficients, the remover omitting coefficients of magnitude greater than the said threshold T.

56. Apparatus for detecting data embedded in material, comprising;

an input for receiving transform coefficients Ci' of the material;

a comparator for comparing the magnitudes of the received coefficients with a threshold Tclip;

a clipper for clipping, to a magnitude Tclip, the magnitude of coefficients of magnitude greater than the said threshold T; and

a correlator for correlating the clipped and unclipped coefficients with a pseudo random symbol sequence to detect data embedded in the material.

57. Apparatus according to claim 56, further comprising a remover for removing data from the clipped and unclipped coefficients.

58. Apparatus for embedding data in material, the apparatus comprising:

an input for receiving transform coefficients Ci representing the material;

a comparator for comparing the magnitudes of the said transform coefficients with a threshold Tclip;

a clipper for clipping, to the magnitude Tclip, the magnitudes of those of the coefficients having a magnitude exceeding Tclip; and

a processor for producing modified coefficients Ci' values dependent on a scaling factor and the data to be embedded, and the scaling factor is calculated using the said clipped coefficients and the coefficients Ci of magnitude less than Tclip.

59. (Amended) A system including embedding apparatus, comprising :

a transformer for producing transform coefficients Ci of the material,

a comparator for comparing the magnitudes of the coefficients with a threshold value T, and

a combiner for producing, from the coefficients Ci and the said data, modified coefficient values Ci' which are modified by respective information symbols of a pseudo random symbol sequence modulated by the said data to be embedded, wherein the combiner does not use coefficients of magnitude greater than the said threshold T and does not use the corresponding information symbols; and detecting apparatus comprising:

an input for receiving transform coefficients of the material;

a comparator for comparing the magnitudes of the received coefficients with a threshold T; and

a correlator for correlating the said coefficients with respective symbols of a pseudo random symbol sequence to detect the said data, wherein the correlation does not use coefficients of magnitude greater than the said threshold T and the corresponding symbols of the pseudo random symbol sequence.

60. (Amended) A method according to claim 32, wherein the said data comprises a UMID.

61. (Amended) A method according to claim 32, wherein the said material comprises video material

62. (Amended) A method according to claim 32, wherein the said material comprises audio material.